

CLAIMS

What is claimed is:

1. A device for the collection and extraction of at least one analyte within a sample, said device comprising:

a vessel;

said vessel defining a chamber for holding said sample;

said chamber having an opening therein;

a neck around said opening extending away from said chamber;

a cap;

said cap selectively attachable to said neck;

said cap having a top cover interior surface in communication with said chamber;

said top cover interior surface having a coated surface;

said coated surface facing said chamber; and

said coated surface having a sorptive coating.

2. The device of claim 2, wherein said sorptive coating comprises at least one selection from the group consisting of:

(a) an immobilized polysiloxane polymer, having two attached functional groups, wherein the first attached functional group is selected from the group consisting of: alkyl, alkenyl, alkynyl, aryl, alkylaryl, alkenylaryl, alkynylaryl, haloalkyl, and haloaryl, and the second attached functional group is selected from the group consisting of: alkyl, alkenyl, alkynyl, aryl, alkylaryl, alkenylaryl, alkynylaryl, haloalkyl, and haloaryl;

(b) a porous layer;

(c) other immobilized polymers above their glass transition temperature;

(d) an immobilized porous polymer;

(e) a sol gel;

(f) an immobilized adsorbent; and

(g) derivatized silica.

3. The device of claim 2, further comprising:

said cap comprising a top cover and a sidewall;

said coated surface being on the interior surface of said top cover;

said top cover having a periphery;

said sidewall attached to said top cover around said periphery to define a cavity bounded by said sidewall and said top cover;

said coated surface being inside said cavity;

- said neck receivable within said cavity; and
said sidewall engaging said neck.
4. The device of claim 2, further comprising:
said top cover including a syringe-permeable orifice.
5. The device of claim 2, wherein said cap selectively attachable to said neck comprises:
said neck having an outer neck surface;
at least one bottle thread helically attached to said outer neck surface;
at least one cap thread helically attached to said sidewall within said cavity; and
said at least one bottle thread and said at least one cap thread engageable to retain said cap on said neck.
6. The device of claim 2, wherein said cap selectively attachable to said neck comprises:
said neck having an outer neck surface;
a rim around said outer neck surface;
said sidewall including a lip; and
said rim retained between said lip and said top cover.
7. The device of claim 2, further comprising:
said cap including a cover periphery, a lower periphery, and a sidewall;
said sidewall extending from said lower periphery to said cover periphery;
said coated surface located on said lower periphery;
said lower periphery being smaller than said cover periphery;
said neck having an interior neck diameter;
said interior neck diameter being larger than said lower periphery and smaller than said cover periphery; and
said neck receiving said cap such that said sidewall fits within a neck interior surface in an interference fit.
8. A device for the collection and extraction of at least one analyte within a sample, said device comprising:
a vessel;
said vessel defining a chamber for holding said sample;
said chamber having an opening therein;
a neck around said opening extending away from said chamber;
a cap;
said cap selectively attachable to said neck;
said cap having a top cover interior surface in communication with said chamber;

- said top cover interior surface having a coated surface;
said coated surface facing said chamber; and
said coated surface having a particulate coating.
9. The device of claim 8, wherein said particulate coating comprises at least one selection from the group consisting of:
- (a) molecular sieves;
 - (b) activated alumina;
 - (c) silica;
 - (d) silica gel;
 - (e) ion exchange resins; and
 - (f) desiccant.
10. The device of claim 9, further comprising:
said cap comprising a top cover and a sidewall;
said coated surface being on the interior surface of said top cover;
said top cover having a periphery;
said sidewall attached to said top cover around said periphery to define a cavity bounded by said sidewall and said top cover;
said coated surface being inside said cavity;
said neck receivable within said cavity; and
said sidewall engaging said neck.
11. The device of claim 9, further comprising:
said top cover including a syringe-permeable orifice.
12. The device of claim 9, wherein said cap selectively attachable to said neck comprises:
said neck having an outer neck surface;
at least one bottle thread helically attached to said outer neck surface;
at least one cap thread helically attached to said sidewall within said cavity; and
said at least one bottle thread and said at least one cap thread engageable to retain said cap on said neck.
13. The device of claim 9, wherein said cap selectively attachable to said neck comprises:
said neck having an outer neck surface;
a rim around said outer neck surface;
said sidewall including a lip; and
said rim retained between said lip and said top cover.
14. The device of claim 9, further comprising:

- said cap including a cover periphery, a lower periphery, and a sidewall;
said sidewall extending from said lower periphery to said cover periphery;
said coated surface located on said lower periphery;
said lower periphery being smaller than said cover periphery;
said neck having an interior neck diameter;
said interior neck diameter being larger than said lower periphery and smaller than said cover periphery; and
said neck receiving said cap such that said sidewall fits within a neck interior surface in an interference fit.
15. A device for the collection and extraction of at least one analyte within a sample, said device comprising:
- a vessel;
 - said vessel defining a chamber for holding said sample;
 - said chamber having an opening therein;
 - a neck around said opening extending away from said chamber;
 - a cap;
 - said cap selectively attachable to said neck;
 - said cap having a top cover interior surface in communication with said chamber;
 - said top cover interior surface having a coated surface;
 - said coated surface facing said chamber;
 - said coated surface selected from the group consisting of: sorptive coating and particulate coating;
 - said sorptive coating comprises at least one selection from the group consisting of:
 - (a) an immobilized polysiloxane polymer, having two attached functional groups, wherein the first attached functional group is selected from the group consisting of: alkyl, alkenyl, alkynyl, aryl, alkylaryl, alkenylaryl, alkynylaryl, haloalkyl, and haloaryl, and the second attached functional group is selected from the group consisting of: alkyl, alkenyl, alkynyl, aryl, alkylaryl, alkenylaryl, alkynylaryl, haloalkyl, and haloaryl;
 - (b) a porous layer;
 - (c) other immobilized polymers above their glass transition temperature;
 - (d) an immobilized porous polymer;
 - (e) a sol gel;
 - (f) an immobilized adsorbent; and

(g) derivatized silica;

said particulate coating comprises at least one selection from the group consisting of:

- (a) molecular sieves;
- (b) activated alumina;
- (c) silica;
- (d) silica gel;
- (e) ion exchange resins, and
- (f) desiccant; and

said cover including a syringe-permeable orifice.

16. A cap for collecting a selected analyte from an analyte-bearing sample when said cap is in communication with a vessel, wherein said cap comprises:

a cover member having an outer cover periphery;

a sidewall extending from said cover member about said outer cover periphery to define a cavity;

said cavity bounded by said sidewall and said cover member;

said cover member having a coated surface inside said cavity;

said cavity receiving said vessel;

said sidewall engaging the neck of said vessel; and

said coated surface having a sorptive coating.

17. The cap of claim 16, wherein said sorptive coating comprises at least one selection from the group consisting of:

(a) an immobilized polysiloxane polymer, having two attached functional groups, wherein the first attached functional group is selected from the group consisting of: alkyl, alkenyl, alkynyl, aryl, alkylaryl, alkenylaryl, alkynylaryl, haloalkyl, and haloaryl, and the second attached functional group is selected from the group consisting of: alkyl, alkenyl, alkynyl, aryl, alkylaryl, alkenylaryl, alkynylaryl, haloalkyl, and haloaryl;

(b) a porous layer;

(c) other immobilized polymers above their glass transition temperature;

(d) an immobilized porous polymer;

(e) a sol gel;

(f) an immobilized adsorbent; and

(g) derivatized silica.

18. The cap of claim 17, further comprising:

said cover member including a syringe-permeable orifice.

19. The cap of claim 17, further comprising:
at least one bottle thread helically attached to said outer neck surface;
at least one cap thread helically attached to said sidewall within said cavity; and
said at least one bottle thread and said at least one cap thread engageable to retain said cap on said neck.
20. The cap of claim 17, further comprising:
a rim around said outer neck surface;
said sidewall including a lip; and
said rim retained between said lip and said cover member.
21. A cap for collecting a selected contaminant from a sample when said cap is in communication with a vessel, wherein said cap comprises:
a cover member having an outer cover periphery;
a sidewall extending from said cover member about said outer cover periphery to define a cavity;
said cavity bounded by said sidewall and said cover member;
said cover member having a coated surface inside said cavity;
said cavity receiving said vessel;
said sidewall engaging the neck of said vessel; and
said coated surface having a particulate coating.
22. The cap of claim 21, wherein said particulate coating comprises at least one selection from the group consisting of:
(a) molecular sieves;
(b) activated alumina;
(c) silica;
(d) silica gel;
(e) ion exchange resins, and;
(f) desiccant;
23. The cap of claim 22, further comprising:
said cover member including a syringe-permeable orifice.
24. The cap of claim 22, further comprising:
at least one bottle thread helically attached to said outer neck surface;
at least one cap thread helically attached to said sidewall within said cavity; and
said at least one bottle thread and said at least one cap thread engageable to retain said cap on said neck.

25. The cap of claim 22, further comprising:
a rim around said outer neck surface;
said sidewall including a lip; and
said rim retained between said lip and said cover member.
26. A cap for closing a vessel, said vessel including a vessel wall, a chamber, and a neck, said neck extending outward from said vessel wall, said neck defining an opening therein providing fluid communication to said chamber, said neck including an outer neck surface, a rim and an inner rim periphery, said cap comprising:
a lower periphery, a cover periphery, a sidewall, and a coated surface;
said sidewall being between said lower periphery and said cover periphery;
said coated surface located within said lower periphery;
said lower periphery being smaller than said cover periphery;
said inner neck periphery being larger than said lower periphery and smaller than said cover periphery; and
said neck receiving said cap such that said sidewall fits within said inner neck periphery in an interference fit.
27. The cap of claim 26, wherein said coated surface is a sorptive coating comprising at least one selection from the group consisting of:
(a) an immobilized polysiloxane polymer, having two attached functional groups, wherein the first attached functional group is selected from the group consisting of: alkyl, alkenyl, alkynyl, aryl, alkylaryl, alkenylaryl, alkynylaryl, haloalkyl, and haloaryl, and the second attached functional group is selected from the group consisting of: alkyl, alkenyl, alkynyl, aryl, alkylaryl, alkenylaryl, alkynylaryl, haloalkyl, and haloaryl;
(b) a porous layer;
(c) other immobilized polymers above their glass transition temperature;
(d) an immobilized porous polymer;
(e) a sol gel;
(f) an immobilized adsorbent; and
(g) derivatized silica.
28. The cap of claim 26, wherein said coated surface is a particulate coating comprising at least one selection from the group consisting of:
(a) molecular sieves;
(b) activated alumina;
(c) silica;

- (d) silica gel;
 - (e) ion exchange resins, and;
 - (f) desiccant;
29. A method for extraction and desorption of one or more analytes in an analyte-bearing sample, said method comprising:
- coating an inner surface of a first cap with a sorptive coating;
 - attaching said first cap to a first vessel containing said analyte-bearing sample;
 - exposing said sorptive coating to said analyte-bearing sample;
 - agitating said first vessel to expose said coating to said analyte-bearing sample for a predetermined period of time;
 - sorptively extracting at least one analyte from said analyte-bearing sample;
 - removing said first cap from said first vessel;
 - attaching a second cap to said first vessel;
 - attaching said first cap to a second vessel;
 - said second vessel containing a solvent;
 - agitating said second vessel to expose said analyte-bearing coating to said solvent;
 - desorbing at least one analyte from said analyte-bearing coating into said solvent; and
 - injecting said analyte-bearing solvent into an analytical device.
30. The method of claim 29, wherein said sorptive coating comprises at least one selection of the group consisting of:
- (a) an immobilized polysiloxane polymer, having two attached functional groups, wherein the first attached functional group is selected from the group consisting of: alkyl, alkenyl, alkynyl, aryl, alkylaryl, alkenylaryl, alkynylaryl, haloalkyl, and haloaryl, and the second attached functional group is selected from the group consisting of: alkyl, alkenyl, alkynyl, aryl, alkylaryl, alkenylaryl, alkynylaryl, haloalkyl, and haloaryl;
 - (b) a porous layer;
 - (c) other immobilized polymers above their glass transition temperature;
 - (d) an immobilized porous polymer;
 - (e) a sol gel;
 - (f) an immobilized adsorbent; and
 - (g) derivatized silica.
31. The method of claim 30, wherein said attaching step further comprises: twisting said cap onto said bottle.
32. The method of claim 30, wherein said attaching step further comprises:

snapping said cap onto said bottle.

33. The method of claim 30, wherein said attaching step further comprises:
plugging said cap into the neck of said bottle until said cap is securely retained within said neck in an interference fit.
34. The method of claim 30, wherein said attaching step further comprises:
crimping said cap onto said bottle.
35. A method for extraction and desorption of one or more analytes in an analyte-bearing sample, said method comprising:
coating an inner surface of a first cap with a sorptive coating;
said sorptive coating selected from the group consisting of:
(a) an immobilized polysiloxane polymer, having two attached functional groups, wherein the first attached functional group is selected from the group consisting of: alkyl, alkenyl, alkynyl, aryl, alkylaryl, alkenylaryl, alkynylaryl, haloalkyl, and haloaryl, and the second attached functional group is selected from the group consisting of: alkyl, alkenyl, alkynyl, aryl, alkylaryl, alkenylaryl, alkynylaryl, haloalkyl, and haloaryl;
(b) a porous layer;
(c) other immobilized polymers above their glass transition temperature;
(d) an immobilized porous polymer;
(e) a sol gel;
(f) an immobilized adsorbent; and
(g) derivatized silica;
attaching said first cap to a first vessel containing said analyte-bearing sample;
exposing said sorptive coating to said analyte-bearing sample;
agitating said first vessel to expose said coating to said analyte-bearing sample for a predetermined period of time;
sorptively extracting at least one analyte from said analyte-bearing sample;
removing said first cap from said first vessel;
attaching a second cap to said first vessel;
attaching said first cap to a second vessel;
said second vessel containing a solvent;
agitating said second vessel to expose said analyte-bearing coating to said solvent;
desorbing at least one analyte from said analyte-bearing coating into said solvent; and
injecting said analyte-bearing solvent into an analytical device.

36. A method for removing one or more contaminants present in an analyte-bearing sample, said method comprising:

coating an inner surface of a first cap with a particulate coating;
attaching said first cap to a first vessel containing said analyte-bearing sample;
exposing said particulate coating to said analyte-bearing sample;
agitating said first vessel for a predetermined period of time;
removing said first cap from said first vessel; and
attaching a second cap to said first vessel.

37. The method of claim 36, wherein said particulate coating comprises at least one selection of the group consisting of:

(a) molecular sieves;
(b) activated alumina;
(c) silica;
(d) silica gel;
(e) ion exchange resins, and
(f) desiccant.

38. The method of claim 37, wherein said attaching step further comprises:
twisting said cap onto said bottle.

39. The method of claim 37, wherein said attaching step further comprises:
snapping said cap onto said bottle.

40. The method of claim 37, wherein said attaching step further comprises:
plugging said cap into the neck of said bottle until said cap is securely retained within said neck in an interference fit.

41. The method of claim 37, wherein said attaching step further comprises:
crimping said cap onto said bottle.

42. The method of claim 37, wherein said second cap comprises a selection from the group consisting of:

an uncoated cap; and
a sorptive-coated cap.

43. The method of claim 42, wherein said sorptive-coated cap is coated with a sorptive coating comprising at least one selection of the group consisting of:

(a) an immobilized polysiloxane polymer, having two attached functional groups, wherein the first attached functional group is selected from the group consisting of: alkyl, alkenyl, alkynyl, aryl, alkylaryl, alkenylaryl, alkynylaryl, haloalkyl, and haloaryl, and the

second attached functional group is selected from the group consisting of: alkyl, alkenyl, alkynyl, aryl, alkylaryl, alkenylaryl, alkynylaryl, haloalkyl, and haloaryl;

- (b) a porous layer;
- (c) other immobilized polymers above their glass transition temperature;
- (d) an immobilized porous polymer;
- (e) a sol gel;
- (f) an immobilized adsorbent; and
- (g) derivatized silica.

44. The method of claim 43, further comprising:

agitating said first vessel to expose said sorptive coating to the analyte-bearing sample for a predetermined period of time;

sorptively extracting at least one analyte from said analyte-bearing sample;

removing said second cap from said first vessel;

attaching a third cap to said first vessel;

providing a second vessel containing a solvent;

attaching said second cap to said second vessel;

agitating said second vessel to expose said analyte-bearing coating to said solvent;

solvently desorbing at least one analyte from said analyte-bearing coating;

withdrawing an aliquot of analyte-bearing solvent; and

injecting said aliquot into an analytical device.

45. A method for performing purification, extraction, and desorption of a sample, said method comprising:

providing a first vessel;

coating the interior surface of said first vessel with a first coating;

providing a first cap;

coating an interior surface of said first cap with a second coating;

pouring said sample into said first vessel;

attaching said first cap to said first vessel;

exposing said first coating and said second coating to said sample;

agitating said first vessel for a predetermined period of time;

sorptively extracting at least one analyte from said sample;

selectively removing at least one contaminant from said sample;

removing said first cap from said first vessel;

attaching a second cap to said first vessel;

attaching said first cap to a second vessel;
said second vessel containing a solvent;
agitating said second vessel;
solvently desorbing at least one analyte;
withdrawing an aliquot of analyte-bearing solvent; and
injecting said analyte-bearing solvent into an analytical device.

46. The method of claim 45, wherein said first coating is a particulate coating comprising at least one selection from the group consisting of:

- (a) molecular sieves;
- (b) activated alumina;
- (c) silica;
- (d) silica gel;
- (e) ion exchange resins, and
- (f) desiccant.

47. The method of claim 45, wherein said second coating is a sorptive coating comprising at least one selection from the group consisting of:

(a) an immobilized polysiloxane polymer, having two attached functional groups, wherein the first attached functional group is selected from the group consisting of: alkyl, alkenyl, alkynyl, aryl, alkylaryl, alkenylaryl, alkynylaryl, haloalkyl, and haloaryl, and the second attached functional group is selected from the group consisting of: alkyl, alkenyl, alkynyl, aryl, alkylaryl, alkenylaryl, alkynylaryl, haloalkyl, and haloaryl;

- (b) a porous layer;
- (c) other immobilized polymers above their glass transition temperature;
- (d) an immobilized porous polymer;
- (e) a sol gel;
- (f) an immobilized adsorbent; and
- (g) derivatized silica.